Key

Semester 1 Exam Review
Practice Problems

1. Methane, CH_4, and ethane, C_2H_6 are both hydrocarbons that exist as gases at room conditions. How many grams of ethane contain the same number of molecules (equal moles) as 6.00 g of methane?

   A. 0.374 grams
   B. 0.09 grams
   C. 80.5 grams
   D. 11.2 grams
   E. 2896 grams

$$6.00\text{g } CH_4 \left| \frac{1\text{ mol } CH_4}{16.04\text{g } CH_4} \right| \frac{1\text{ mol } C_2H_6}{1\text{ mol } CH_4} \left| \frac{30.07\text{g } C_2H_6}{1\text{ mol } C_2H_6} \right. = 11.2\text{g}$$

2. A mass of 21.5 grams of calcium hydroxide reacts with an excess of phosphoric acid. What mass of calcium phosphate could be recovered from solution?

   A. 31.6 grams (I guess)
   B. 326 grams
   C. 94.7 grams
   D. 284 grams
   E. 186 grams

$$3Ca(OH)_2 + 2H_3PO_4 \longrightarrow Ca_3(PO_4)_2 + 6H_2O$$

$$21.5\text{g } Ca(OH)_2 \left| \frac{1\text{ mol}}{74.10\text{g}} \right| \frac{1\text{ mol } Ca_3(PO_4)_2}{3\text{ mol } Ca(OH)_2} \left| \frac{310.18\text{g}}{1\text{ mol}} \right. = 30.0\text{g}$$

3. A sample of an alcohol is tested and found to contain 52% carbon, 35% oxygen, and 13% hydrogen by mass. Tests indicate that the molecular weight of the molecule is between 30 and 80. What is the molecular formula of the alcohol?

   A. CH_3OH
   B. C_3H_7OH
   C. C_2H_5OH
   D. C_4H_9OH
   E. $C_5H_{11}OH$

$$\frac{52\text{g C}}{12.01\text{g C}} \left| \frac{1\text{ mol}}{} \right. = \frac{4.33\text{ mol C}}{2.19} = 2\text{ mol C}$$

$$\frac{35\text{g O}}{16.00\text{g O}} \left| \frac{1\text{ mol}}{} \right. = \frac{2.19\text{ mol O}}{2.19} = 1\text{ mol O}$$

$$\frac{13\text{g H}}{1.008\text{g H}} \left| \frac{1\text{ mol}}{} \right. = \frac{12.90\text{ mol H}}{2.19} = 5.9\text{ mol H}$$

C_2H_6O

4. 18.0 grams of carbon is burned in 55.0 grams of oxygen. How many grams of carbon dioxide are formed?

$$C + O_2 \longrightarrow CO_2$$

   A. 75.6 grams CO_2
   B. 66.0 grams CO_2
   C. 151 grams CO_2
   D. 12.01 grams CO_2
   E. 44.01 grams CO_2

$$\frac{18\text{g C}}{12.01\text{g C}} \left| \frac{1\text{ mol}}{1\text{ mol}} \right| \frac{44.01\text{g } CO_2}{1\text{ mol } CO_2} \left. = 65.96\text{g } CO_2 \right.$$

$$\frac{55\text{g } O_2}{32.00\text{g}} \left| \frac{1\text{ mol}}{1\text{ mol}} \right| \frac{44.01\text{g } CO_2}{1\text{ mol } CO_2} \left. = 75.64\text{g } CO_2 \right.$$

5. When the equation for the combustion of ethane, C_2H_6, is correctly balanced, the coefficient on oxygen is:

A. 3
B. 1
C. 7
D. 5
E. 9

$2C_2H_6 + 7O_2 \longrightarrow 4CO_2 + 6H_2O$

6. Given the equation 3A + 4B → 2C + 3D, you react 5 moles of A with 7 moles of B. Which of the following statements is true?

$\frac{5}{3} < \frac{7}{4}$

A. A is the limiting reactant
B. B is the limiting reactant
C. A and B are in ideal stoichiometric proportions
D. A has a greater molar mass than B
E. B has a greater molar mass than A

since 5 mol A/3 is less than 7 mol B/5, A is limiting

7. When solutions of sodium nitrate and potassium chloride are mixed, which of the following will be present in the net ionic equation?

A. Na^+
B. NaCl(aq)
C. KNO_3(s)
D. Cl^-
E. None of these

$Na^+ + NO_3^- + K^+ + Cl^- \longrightarrow$

there are no insoluble products, so the reaction does not happen.

8. A 25.0-g sample of sodium hydroxide is dissolved in 400. mL of water. What is the concentration of the solution?

should say dissolved to produce 400 mL of solution

A. 100. M
B. 1.56×10^{-3} M
C. 1.56 M
D. 62.5 M
E. 0.10 M

$\frac{25\text{ g NaOH}}{400\text{ mL}} \left| \frac{1\text{ mol}}{39.998\text{ g}} \right| \frac{1000\text{ mL}}{1\text{ L soln}} = 1.56\text{ M}$

9. A 500 mL sample of a 0.350 M solution is left open on a lab counter for two weeks, after which the concentration of the solution is 0.955 M. What is the new volume of the solution?

A. 183 L
B. 223 mL
C. 1.83 mL
D. 0.605 L
E. 0.183 L

$M_1V_1 = M_2V_2$

$.350(500\text{ mL}) = .955\,V_2$

$V_2 = 183\text{ mL}$

10. Which of the following ions is most likely to combine with an anion to form an insoluble salt?

A. Potassium B. sulfide C. Ammonium
D. Silver E. sodium

11. In which of the following compounds does sulfur have an oxidation state of +4?

A. H_2SO_4 +6
B. H_2S -2
C. SO_3 +6
D. H_2SO_3 +4
E. $MgSO_4$ +6

12. $\overset{+}{Na}\overset{-}{Cl} + H_2\overset{2-}{S}O_4 + \overset{+4}{Mn}O_2 \rightarrow \overset{+}{Na}_2\overset{2-}{S}O_4 + \overset{+2}{Mn}SO_4 + H_2O + \overset{0}{Cl}_2$

LEO GER
Lose e's = oxidized

In this reaction, the ___ ion is oxidized.

A. Na^+ B. H^+ C. Mn^{4+} D. Cl^- E. O^{2-}

13. All of the following are weak acids except:

A. HNO_3 B. HF C. H_2S D. HClO E. H_2CO_3

14. An 8.25 L sample of oxygen is collected at 25°C and 1.022 atm pressure. What volume will the gas occupy .940 atm and -15°C?

A. 7.77 L
B. 5.00 L
C. 8.76 L
D. 1.78 L
E. 10.4 L

$$\frac{1.022\,(8.25)}{298\,K} = \frac{.940\,V_2}{258\,K}$$

$V_2 = 7.77\,L$

15. A motorist fills his car tires to 32 lb/in^2 pressure at a temperature of 30°C. Assuming no change in volume, what will the pressure in the tires be when the motorist drives across Death Valley, with a pavement temperature of 78°C?

A. 37 lb/in^2
B. 12 lb/in^2
C. 28 lb/in^2
D. 4.8 lb/in^2
E. 83 lb/in^2

$$\frac{P_1}{T_1} = \frac{P_2}{T_2} \qquad \frac{32\,psi}{303\,K} = \frac{P_2}{351\,K}$$

$P_2 = 37.1\,psi$

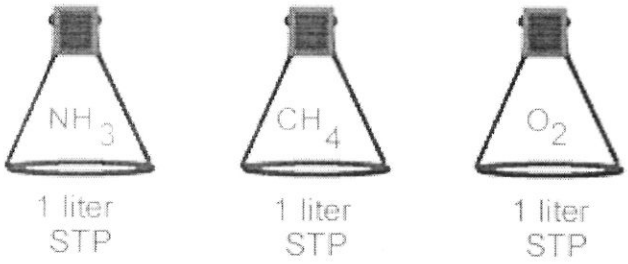
16. How many moles of gas would it take to fill an average man's lungs, total capacity of which is about 4.5 liters? Assume 1.00 atm pressure and 37.0°C.

A. 0.75 mol
B. 11.2 mol
C. 0.18 mole
D. 37.0 mol
E. 1.24 mol

$PV = nRT$

$1.00\,(4.5) = n\,(0.08206)\,310K$

$n = .177\,mol$



17. Which flask contains the greatest number of molecules?
    A. Flask 1 (NH_3)
    B. Flask 2 (CH_4)
    C. Flask 3 (O_2)
    D. Flasks 2 and 3
    E. All are the same – Avogadro's principle

18. In which flask do the molecules have the highest average velocity?

    A. Flask 1 (NH_3) – 17.03 g/mol
    B. Flask 2 (CH_4) – 16.04 g/mol
    C. Flask 3 (O_2) – 32 g/mol
    D. Flasks 2 and 3
    E. All are the same

19. Flask(s) _____ is/are most likely to exhibit ideal behavior because _____.

    A. Flask 1 (NH_3) because it has the lowest molar mass.
    B. Flask 2 and flask 3 because methane and oxygen are nonpolar molecules.
    C. Flask 1 (NH_3) because ammonia is a polar molecule.
    D. Flask 3 (O_2) because it has the greatest molar mass.
    E. Flask 2 (CH_4) because it is a hydrocarbon.

– CH_4 is more ideal than O_2 because it is smaller

20. 325 mL of a gas at STP has a mass of .805 grams. What is the molar mass of the gaseous compound?

    A. 0.0555 g/mol
    B. 55.5 g/mol
    C. 31.7 g/mol
    D. 9.04 g/mol
    E. None of these

$PV = nRT$

$1.00(.3252) = n(.08206)273$

$n = .01451 \text{ mol}$

$M = \frac{.805 \text{ g}}{.01451 \text{ mol}} = 55.5 \text{ g/mol}$

21. What is the ratio of the effusion rates of O_2 and SO_2?
    A. 1.4
    B. 0.71
    C. 0.50
    D. 2.0
    E. None of these

$\frac{\text{Rate 1}}{\text{Rate 2}} = \frac{\sqrt{M_2}}{\sqrt{M_1}} = \frac{\sqrt{64.06}}{\sqrt{32}} = 1.41$

23. A sample of wood has a heat of combustion of 3.29 kJ/g. What quantity of the wood must be burned to heat 250. g of water from 18°C to 85°C? Once again, the specific heat capacity of water is 4.18 J/°C·g.

A. 12.4 g
B. 0.45 g
C. 21.3 g
D. 2.13×10^4 g
E. 85.1 g

$Q = m \Delta T c$

$Q = 250\,(67)\,4.18$

$Q = 70{,}015\ J \left| \frac{1\ kJ}{1000\ J} \right| \frac{1\ g}{3.29\ kJ} = 21.3\ g$

24. The specific heat of liquid water is 4.18 J/°C·g and the specific heat of carbon is 0.71 J/°C·g. A 10 gram sample of water and a 10 gram sample of carbon are each subjected to 155 J of heat. If both samples started at 25°C, which substance will have the higher final temperature, and by what magnitude?

$155 = 10\,\Delta T\,(.71)$ $\quad \Delta T = 21.8°C$ $\quad 155 = 10\,\Delta T\,(4.18)$ $\quad \Delta T = 3.71°C$

A. water, by 3.47°C
B. Neither. They will have the same final temperature because the started at the same temperature and were exposed to the same quantity of heat.
C. water, by 28.7°C
D. carbon, by 18.1°C
E. carbon, by 215°C

$21.8 - 3.7 = 18.1°C$

smaller spec. heat = greater temp change

25. Using the information below, calculate ΔH for the following reaction:

$PbO(s) + CO(g) \rightarrow Pb(s) + CO_2(g)$ $\quad \Delta H^\circ_{f\,prod} - \Delta H^\circ_{f\,react}$

ΔH°_f for $CO_2(g) = -393.5$ kJ/mol

ΔH°_f for $PbO(s) = -151.6$ kJ/mol

ΔH°_f for $CO(g) = -110.5$ kJ/mol

$\Delta H = -393.5 - (-151.6) - (-110.5)$

$\Delta H = -131.4$ kJ/mol

A. -131.4 kJ/mol
B. -655.6 kJ/mol
C. +131.4.0 kJ/mol
D. +655.6 kJ/mol

26. Given the following data:

I. $K(s) \rightarrow K(g) + 90.\ kJ$
II. $K(g) \rightarrow K^+(g) + e^- + 419$ kJ
III. $F_2(g) \rightarrow 2F(g) + 151$ kJ
IV. $F^-(g) \rightarrow F(g) + e^- + 333$ kJ
V. $KF(s) \rightarrow K^+(g) + F^-(g) + 803$ kJ

Calculate ΔH for the reaction $K(s) + 1/2F_2(g) \rightarrow KF(s)$

A. 317 kJ
B. -401 kJ
C. 1796 kJ
D. -552 kJ
E. -1721 kJ

	Rxn	kJ
①	$K^+_{(g)} + F^-_{(g)} \rightarrow KF_{(s)}$	−803
②	$K_{(s)} \rightarrow K_{(g)}$	+90
③	$K_{(g)} \rightarrow K^+_{(g)} + e^-$	+419
④	$\frac{1}{2} F_{2(g)} \rightarrow F_{(g)}$	+70.5
⑤	$F_{(g)} + e^- \rightarrow F^-_{(g)}$	−333
	$K_{(s)} + \frac{1}{2} F_{2(g)} \rightarrow KF_{(s)}$	−556 kJ/mol

② ④ ① ③ ⑤

Hess's Law on the test won't be this long.